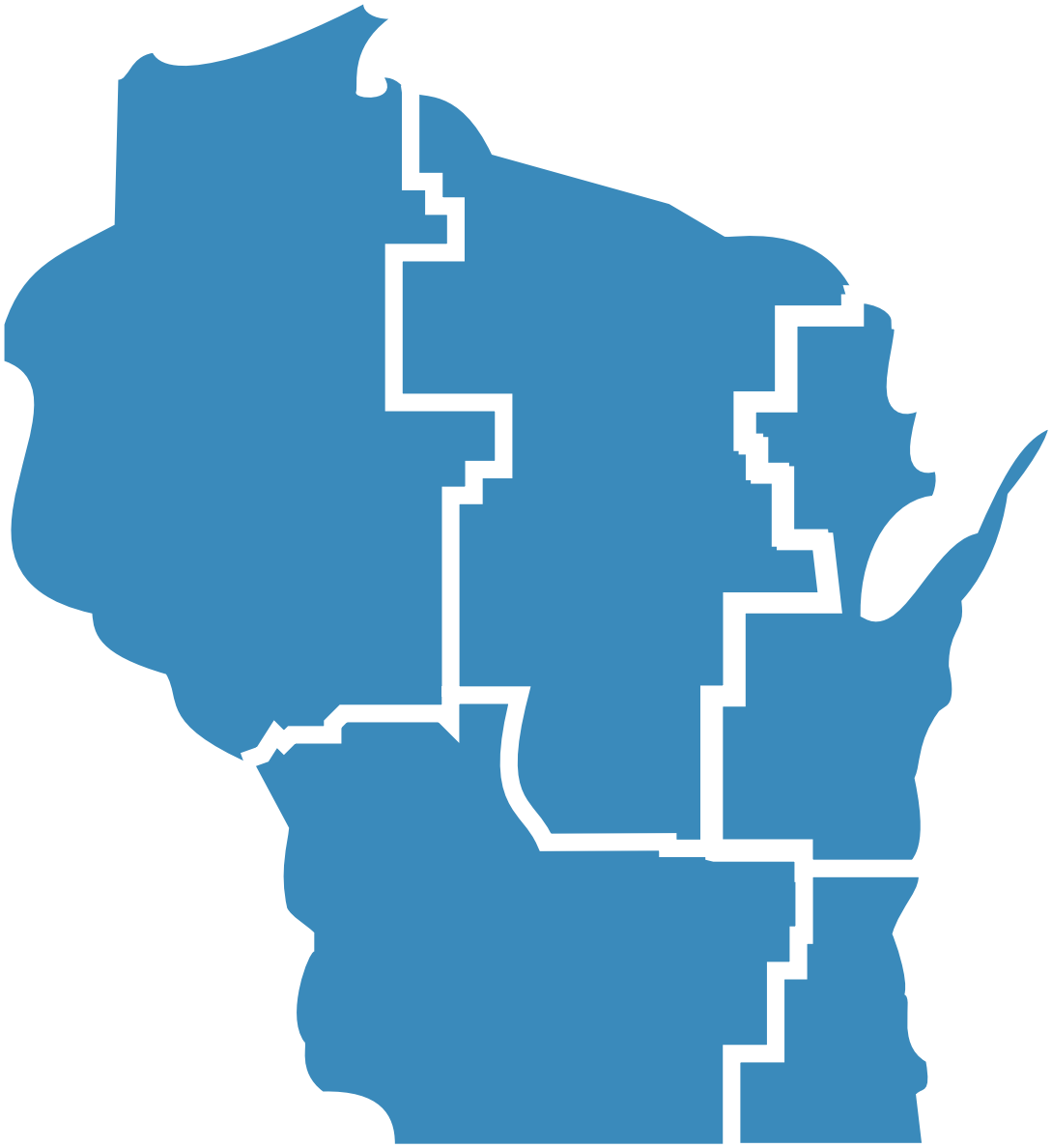
Wisconsin Department of Transportation

Annual Evaluation
2005
WisDOT Research Program



This is an evaluation of research and technology transfer activities carried out by the Wisconsin Department of Transportation and its partners through the Part II research portion of the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation. The evaluation reports on activities during Federal Fiscal Year 2005, covering October 1, 2004, through September 30, 2005.

WisDOT 2005 Research Program Evaluation

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Acronyms

DOT	Department of Transportation
DBM	Division of Business Management
DTSD	Division of Transportation System Development
FFY	Federal Fiscal Year
FHWA	Federal Highway Administration
HMA	Hot-Mix Asphalt
ISTEA	Intermodal Surface Transportation Efficiency Act (1991)
MRUTC	Midwest Regional University Transportation Center
NCHRP	National Cooperative Highway Research Program
PCC	Portland Cement Concrete
RCSS	Research and Communication Services Section
RD&T	Research, Development and Technology Transfer
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
SPR	State Planning and Research
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
WCMSC	Wisconsin Construction and Materials Support Center
WHRP	Wisconsin Highway Research Program
WisDOT	Wisconsin Department of Transportation

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Introduction

This is the second formal evaluation of WisDOT's Research Program since it was restructured in 1998. The first evaluation in 2003 covered four fiscal years, FFY 2000 through 2003. In addition we published ***Annual Reports*** for each fiscal year from 2000 through 2004. Beginning with this ***Annual Evaluation*** for FFY 2005, we are combining the two publications into one document with a stronger focus on measuring the impacts and benefits of SPR-funded research.

Describing and evaluating research activities

The purpose of this evaluation is to clearly and concisely identify:

Who we are — WisDOT staff who plan and oversee the research program

What we do — The recurring activities required to manage the research program

Our research partners — Organizations and individuals who work with us

Summary observations — Challenges, accomplishments and looking ahead

Impacts — How research activities and projects have made a difference to the department

Current and new research projects — Listed in a separate Project Reference Guide

Using data and customer input

To accomplish this review, we compiled financial, contract, and project information from the past year. We interviewed numerous individuals within the department and among our partners to identify research impacts. We also reflected on the changes that have occurred within and outside the department that have affected our research efforts.

Focusing on WisDOT emphasis areas

We see research as critical to realizing WisDOT's vision: "Dedicated people creating transportation solutions through innovation and exceptional service." Innovations discovered through research can have significant impacts on WisDOT's emphasis areas: maintain a quality workforce; anticipate and meet our customers' needs; increase efficiency; promote transportation safety…and security; and create economic opportunities. In this evaluation, we have tried to demonstrate the impacts of research projects and other research-related activities. Our aim is to continuously improve the department's research program and make it increasingly valuable by focusing on outcomes and implementation of results into practice.

Working together

WisDOT's research program would not be possible without the dedication of the many WisDOT employees who devote significant amounts of time and energy to overseeing needed projects and improving practices based on study results. The active participation of industry representatives is also critical to the success of the research program. We are extremely fortunate in Wisconsin to enjoy the services of very high caliber investigators from both the university and consultant sectors; their expertise is irreplaceable. Finally, we appreciate the supportive working relationship we have with the FHWA Wisconsin Division Office and its dedicated staff.

Nina McLawhorn
Research Administrator
Research and Library Unit
Wisconsin Department of Transportation
4802 Sheboygan Avenue, Room 851
Madison, Wisconsin 53707

Kristina Boardman
Section Chief – Acting Research Administrator
Research and Communication Services Section
Wisconsin Department of Transportation
4802 Sheboygan Avenue, Room 701
Madison, Wisconsin 53707

Who We Are

Research activities at WisDOT involve many people—from the Executive Offices, from all five divisions and regional offices, and from many bureaus. Our small unit depends on agency-wide involvement to identify and implement research that advances WisDOT's mission to "Provide leadership in the development and operation of a safe and efficient transportation system." We strive to manage WisDOT research and associated funding with the needs of the entire department in mind.

WisDOT Research and Library Unit

www.dot.wisconsin.gov/library/research/reports

As a result of WisDOT's reorganization in July 2005, the former Research Coordination Section was moved to the Division of Business Management and merged with the WisDOT Library as part of the Research and Communication Services Section. RCSS, which also includes visual design, multi-media, Web services and organizational accountability, carried out a strategic planning process in late 2005 that defined the section's mission as "a department-wide resource for creative, cost-effective knowledge transfer essential to a safe and efficient transportation system."

The Research and Library Unit's placement within RCSS reinforces the emphasis given in recent years to the dissemination and implementation of research results, with increasing attention to library and information services and knowledge management. The new Research and Library Unit strives to provide services and products to the department in the following broad areas of research: analysis and synthesis of existing research, identification of research needs, research project oversight, implementation of results, and technology transfer.

Research Staff

Nina McLawhorn	Research Administrator
Ann Pahnke	Lead Program Analyst
John Glaze	Program Analyst

Funding

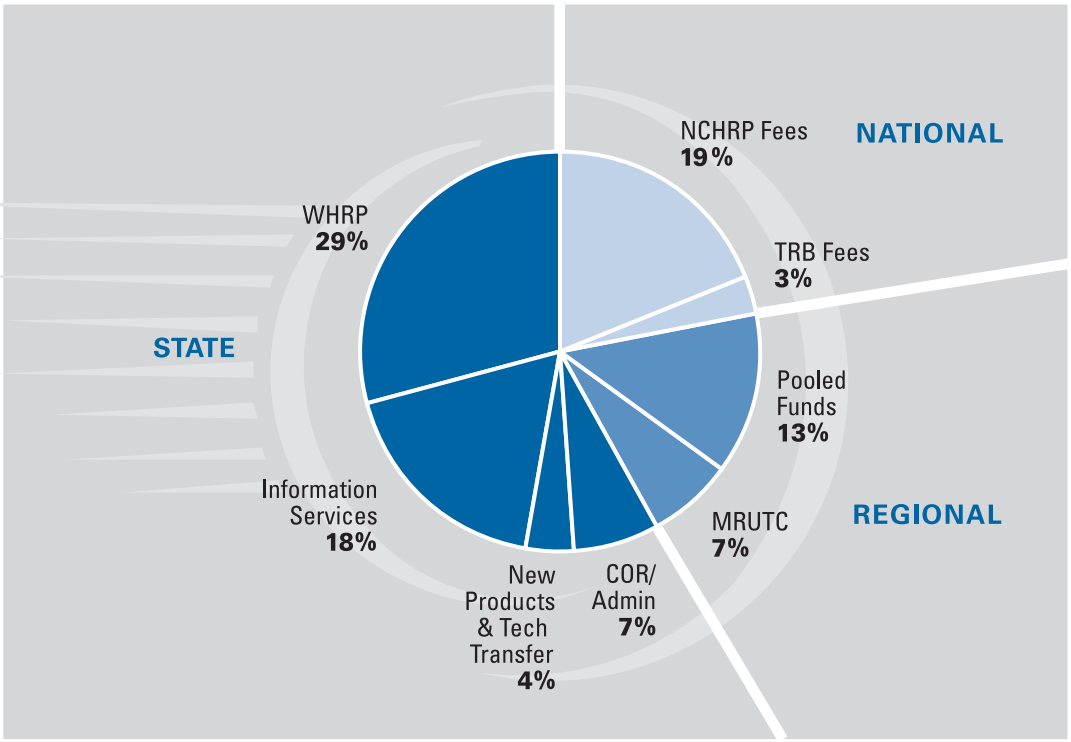
WisDOT's Research and Library Unit manages all aspects of the approximately $3.5 million research portion of WisDOT's State Planning and Research Program. The SPR program was reauthorized in the recently enacted ***Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU),*** which provides funding for FFY 2005 through 2009. Some research activities and projects can be authorized by FHWA to use 100% SPR funds; others must be matched, usually on an 80%/20% basis with state or other funds. WisDOT also receives some research grant money directly from FHWA, which the Research and Library Unit is also responsible for managing.

FFY 2005 Expenditures

100% Federal Funds	
NCHRP Fees	$669,000
TRB Fees	$120,000
Pooled Fund Projects	$460,000
MRUTC	$260,000
	$1,509,000

80%/20% Projects	
COR/Administration	$254,000
New Product Testing/Tech Transfer	$129,000
Information Services	$644,000
WHRP	$1,005,000
	$2,032,000
Total	**$3,541,000**

Note: Expenditure amounts for FFY 2005 may vary from current annual program commitments due to carryovers and prepayments.



National Expenditures – 22%

Payment of TRB and NCHRP fees enables WisDOT to participate in the selection of more than $30 million of transportation research each year, addressing every business area of the department. We benefit on an ongoing basis from the continuous stream of research generated through TRB programs, publications and other resources, especially the preeminent Annual Meeting, attended by nearly 10,000 transportation professionals from around the world. We are only a phone call or e-mail away from the specialized expertise of more than 100 TRB staff members.

Regional Expenditures – 20%

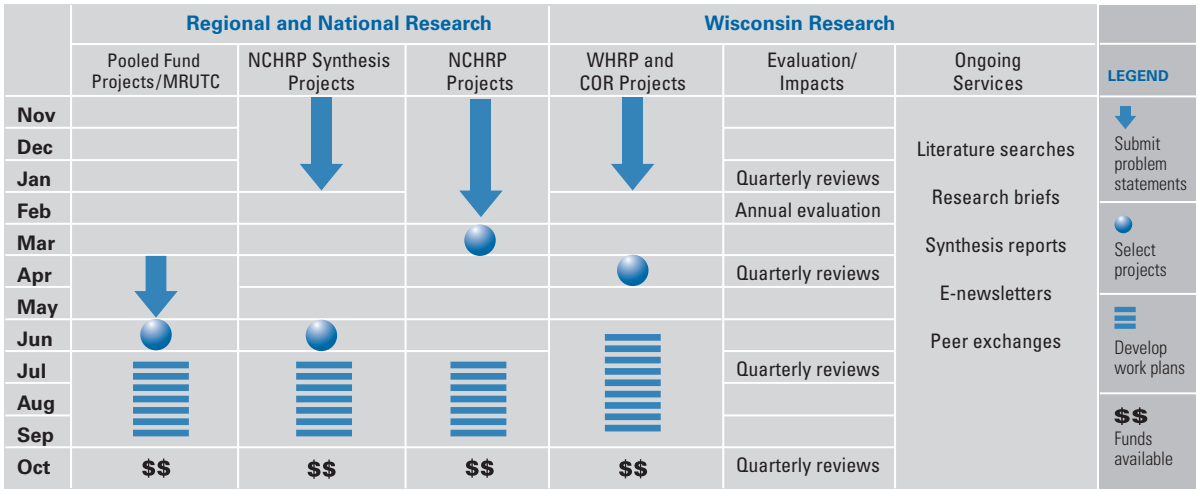
Our contributions to the regional University Transportation Center at UW–Madison and to other pooled fund research projects enable us to pursue common research goals in cooperation with neighboring states, leveraging our investment many times over.

State Expenditures – 58%

We strive to maintain a balanced investment in state research: materials and construction research through WHRP; planning, operations and environmental research through COR; new product evaluation and technology transfer efforts through the Bureau of Technical Services; and information services aimed at effective use of existing research and at implementation of results into practice.

What We Do

The Research and Library Unit manages the many aspects of the research program through an annual cycle of activities outlined in the timeline below. These activities include soliciting research problem statements, selecting high-priority projects, publishing requests for proposals, selecting the best proposal to meet each project's objectives, contracting with investigator agencies, monitoring research progress, reviewing final reports, communicating results, encouraging implementation into practice, and evaluating benefits to the department. We communicate regularly with research partners and formally review progress on a quarterly basis.



Throughout the year, the Research and Library Unit strives to meet the following broad objectives:

Fund research that meets strategic objectives

We manage the annual solicitation of research needs with the goal of funding those projects that are most clearly tied to WisDOT strategic objectives. The research program funds ***applied research***—research focused on developing usable solutions to specific problems.

Manage the program and its finances

We administer the research portion of the State Planning and Research program according to FHWA rules. Major responsibilities include preparing detailed descriptive and financial information for the SPR Annual Work Program, monitoring activities to ensure that work is being performed properly and on time, reviewing contracts and invoices, and evaluating the overall research program with a focus on outcomes and implementation.

Deliver information services

Through a technical communications consulting firm, we provide literature searches, information syntheses and other services to WisDOT staff and partners in order to capitalize on existing research and the work of organizations such as TRB and AASHTO. We deliver technical information products and marketing services for completed research—such as research briefs, e-newsletters, annual reports, multi-media presentations, training and surveys—to improve the impact and value of research in the department. We facilitate peer exchanges within WisDOT bureaus to help access national and regional expertise and best practices.

Encourage WisDOT and partner cooperation

We strive to enhance cooperation between WisDOT and its research partners in order to leverage our limited resources, to focus on the most important problems, to avoid duplication and to hasten implementation of results into practice.

Our Research Partners
State, Regional, National

To carry out needed research, the Research and Library Unit maintains partnerships with other WisDOT staff as well as with personnel in industry and academia, at other agencies, and at FHWA. We draw on resources within Wisconsin, regionally and at the national level. The experience, specialized expertise and diverse points of view of these many individuals and organizations help assure that we are focusing on the highest priority problems and are addressing the problems in the most effective way for the department.

Council on Research

The Council on Research, composed of representatives from WisDOT's divisions and Executive Offices, works with the Research Administrator to identify needed research outside the fields of highway materials and construction. With a focus on the department's strategic initiatives, COR members review and select research proposals in key areas such as policy and planning, operations, safety, environment, and transit. Our current annual commitment to COR is approximately $300,000.

COR Steering Committee (pre-reorganization)

Ron Adams	Infrastructure Development
Bonnie Anderson	Motor Vehicles
Rod Clark	Investment Management
Jim Etmanczyk	Business Management
Joe Maassen	Executive Offices
Dwight McComb	FHWA
Dan McGuire	State Patrol
Alan Rommel	Districts

Wisconsin Highway Research Program

www.whrp.org

In recent years, we have increasingly relied on the expertise of Wisconsin's university professors and students to carry out needed research. University of Wisconsin–Madison staff also serve in an administrative role as managers of the Wisconsin Highway Research Program. WHRP's mission is to conduct materials and construction research aimed at extending the service life of the state's highways and structures. Multi-partnered committees representing WisDOT, industry, academia and FHWA select and monitor projects.

Our current annual commitment to WHRP is approximately $1,000,000.

WHRP Administration

Hussain Bahia, *Technical Director*
UW–Madison

Greg Waidley, *Program Manager*
UW–Madison

WHRP Steering Committee

Nina McLawhorn, *Chair*
WisDOT Bureau of Business Management

Don Miller
WisDOT Bureau of Project Development

Beth Cannestra
WisDOT Bureau of Structures

Dan McGuire
WisDOT Bureau of Technical Services

Alan Rommel
WisDOT NE Region

Dwight McComb
FHWA–Wisconsin

Teresa Adams
UW–Madison (Academic representative; rotates annually)

Matt Grove
Wisconsin Transportation Builders Association

Mike Paddock
American Council of Engineering Companies of WI

Kevin McMullen
Wisconsin Concrete Pavement Association

Scot Schwandt
Wisconsin Asphalt Pavement Association

Jack Arseneau
Wisconsin Earthmovers Association

WHRP TOC Chairs

Jim Parry, Rigid Pavement
WisDOT Bureau of Technical Services

Len Makowski, Flexible Pavement
WisDOT SE Region

Bob Arndorfer, Geotechnics
WisDOT Bureau of Technical Services

Scot Becker, Structures
WisDOT Bureau of Structures

New Product Evaluation/ Technology Transfer

The Research Program has traditionally provided funding for activities now carried out by the Bureau of Technical Services in the Division of Transportation System Development. These activities include preparation of WisDOT's Product Acceptability List for erosion control products as well as certain technology transfer activities on behalf of staff in the Regional Offices. Our current annual commitment to DTSD is approximately $130,000.

Bureau of Technical Services

Dan McGuire
Director

Pete Kemp
New Product Engineer

Wisconsin Construction and Materials Support Center

Formed in 2005, this new partnership venture with UW–Madison will support the applied-research needs of WisDOT's Bureau of Project Development on a work-order, rapid-turnaround basis. With the guidance of a steering committee and full-time program manager to be hired in April 2006, WCMSC will access the expertise of university faculty and students to support WisDOT staff, consultants and contractors in implementing important new technologies and practices. The WCMSC is a $250,000 two-year pilot program, funded with $75,000 per year from the WHRP program and $50,000 per year from the Bureau of Project Development.

WCMSC Steering Committee

Don Miller
WisDOT Bureau of Project Development

Dan McGuire
WisDOT Bureau of Technical Services

Nina McLawhorn
WisDOT Bureau of Business Management

UW–Madison Representative

FHWA–Wisconsin Division Representative

CTC & Associates LLC – Technical Communications Consultants

www.ctcandassociates.com

Since 2000 WisDOT has contracted with CTC & Associates LLC for technical communications services in support of the research program. These services add value to research projects by improving communication of results to users and encouraging implementation. CTC also fills needs not met by traditional research through the delivery of quick-turnaround information products in both technical and policy areas. CTC provides training and consulting support to staff in the research program and bureaus throughout the department. Our current annual commitment to CTC & Associates is $300,000.

CTC & Associates Staff

Patrick Casey
Principal

Kimberly Linsenmayer
Senior Associate

Andrea Thomas
Associate – Research, editing, writing

Matthew Mullins
Associate – Research, writing

Richard Mulhern
Associate – Research, writing

Margaret Sacco
Associate – Technical Library Services

University Transportation Center

www.mrutc.org

UW–Madison operates the Midwest Regional University Transportation Center, a multi-state, multi-university effort focused on the Optimization of Transportation Investment and Operations. WisDOT's membership on MRUTC's Executive and Advisory Committees gives it the opportunity to propose research ideas and gain significant benefits from reports, workshops and other activities carried out by the center. MRUTC is competing for re-designation and multi-year funding from U.S. DOT to begin October 2006. UW–Madison was also designated in SAFETEA-LU as a National Transportation Center for freight issues, to begin in October 2006. Our current annual commitment to MRUTC is approximately $200,000.

MRUTC Administration (UW–Madison)

Teresa Adams
Director

Jason Bittner
Deputy Director

Greg Waidley
Research Manager

Howard Rosen
Director of Continuing Education

Pooled Fund Research

www.pooledfund.org

This valuable program sponsored by FHWA, TRB and AASHTO provides a way for federal, state and local transportation agencies and other organizations to pool their funds in support of collectively important research. A committee composed of technical representatives from each partner organization oversees each project and takes responsibility for disseminating useful results. Our current annual commitment to pooled fund projects is approximately $300,000.

Federal Highway Administration

www.fhwa.dot.gov

FHWA provides major funding for WisDOT's research efforts. The State Planning and Research program under which WisDOT administers these funds was established in the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), continued with the 1998 Transportation Equity Act for the 21st Century (TEA-21), and is currently authorized in the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Research and Library Unit works closely with the FHWA–Wisconsin Division in the administration of the research program. In addition, individual FHWA staff members contribute their expertise as members of policy and project oversight committees and other research work groups.

American Association of State Highway and Transportation Officials

www.transportation.org

Through membership on AASHTO's standing committees and its Research Advisory Committee, WisDOT has the opportunity to help shape the national research agenda. The department benefits from the many programs, services and products of AASHTO, such as the Center for Environmental Excellence, the Technology Implementation Group, the Materials Reference Laboratory, the Product Evaluation Program, and AASHTOWare. AASHTOWare software products are available exclusively to state DOTS for many critical management functions, including all aspects of highway construction; bridge management, rating and design; pavement analysis and design; survey data management; safety information management; and many others.

Transportation Research Board

www.trb.org

Every business area of WisDOT benefits from TRB's multi-million-dollar annual research program. AASHTO committees specifically request many of these research projects. The continuous stream of research products generated from TRB programs offer immediate and usable solutions to transportation practitioners. WisDOT staff and partners from academia and industry are among the nearly 10,000 transportation professionals from around the world who attend the TRB Annual Meeting each January in Washington, D.C. See the **Wisconsin TRB Guide** at *www.dot.wisconsin.gov/library/research/reports* for Wisconsin TRB committee memberships and for presentations given by Wisconsin investigators, students and practitioners. Many of the technical papers listed were supported through funding from the WisDOT Research Program. Our current annual commitment to TRB is approximately $120,000.

National Cooperative Highway Research Program

www4.trb.org/trb/crp.nsf

WisDOT joins other states to cooperatively fund NCHRP at a level of approximately $30 million per year. NCHRP is an applied research program focused on operational problems of transportation engineers and administrators. For FFY 2006, 51 new projects were approved ($22.25 million) and 22 existing projects received continuation funding ($10.27 million), covering a broad range of transportation research areas. WisDOT has an opportunity to guide project selection and to oversee individual projects by serving on NCHRP project panels. See the **Wisconsin TRB Guide** at *www.dot.wisconsin.gov/library/research/reports* for WisDOT panel members. Our current annual commitment to NCHRP is approximately $670,000.

Summary Observations

As we reflected back on 2005 and looked ahead to the future, we distilled a number of observations. We identify here some of the challenges we faced, accomplishments and milestones, and our commitments for the coming year.

CHALLENGES

Change and uncertainty characterized transportation research in 2005—at the state, regional and national levels. We learned much as we addressed these challenges and sought to:

- Provide existing and new services while building relationships with new people and programs. The year saw many changes in personnel within WisDOT, at UW–Madison and FHWA–Wisconsin, and among our national administrative contacts.
- Make good budgeting decisions in spite of delays in reauthorization of the national transportation act and funding uncertainties at the state level that affected available match funds.
- Communicate the value of the research program as a resource to the entire department during a time of shrinking resources.
- Provide effective management of the five pooled fund research projects for which we assumed lead state responsibilities, despite increased workload in the Research and Library Unit and unresolved administrative problems at the national level.

ACCOMPLISHMENTS

Program Management

The research program is a strategic asset to the department and all of its employees.

- We continued to communicate the value of research and information management to the 21st century transportation agency. Our brochure and video on Transportation in the Information Age are being used by agencies around the nation to raise awareness of the critical importance of knowledge assets.
- We led a strategic planning process within the new Research and Communication Services Section that resulted in mission, vision and goal statements as well as an integrated approach to delivering services.
- We met with leadership of each of the newly reorganized WisDOT divisions to identify and prioritize needs for research and communication services in the coming year.
- We began measuring the impacts of research activities on the department and its customers through follow-up surveys, standard research closure and impact forms, and by requesting that project managers try to estimate dollar savings from incorporation of research results into WisDOT procedures.
- The Technical Director explained the value and impact of WHRP in formal presentations to numerous WisDOT and industry groups.
- We were able to maintain financial commitments and effectively use available funding for identified research needs.

Project Management

Continuous monitoring of research projects and other activities is vital to assure high-quality, timely delivery of reports and usable results.

- We maintained consistent oversight of nearly 60 active research projects during FFY 2005.
- Seventeen projects were completed and 14 new projects were launched.
- WHRP management worked hard to reduce a backlog of overdue projects, instituting clear expectations for meeting agreed-upon deadlines.
- WHRP management exceeded the performance goal for quarterly reports submitted on a timely basis.
- WHRP leadership strongly emphasized the importance of implementing research results and measuring tangible benefits, an effort that was called for in the 2003 Program Evaluation. Four implementation projects were approved for FFY 2006 to help speed research results into practice.
- We organized constructive dialogue with FHWA, WisDOT financial services personnel and other states in an attempt to simplify lead state administrative processes for management of pooled fund projects.

Partnering

Working cooperatively with many parties within the department and outside of it enables us to achieve much more than we could by ourselves.

- We brought new research and management expertise into the program through successful partnering with universities and consultants. This became an essential component of our efforts, especially in the new resource-constrained environment.
- Our partnership with the UW–Madison has become stronger and more effective in 2005, thanks to improved communication and cooperation.
- We supplemented our financial support to WHRP, enabling increased technical services to WisDOT.
- Through our participation in pooled fund projects with other state DOTs we are able to leverage annual contributions of approximately $300,000 into more than $6 million of cooperative research each year.

Regional and National Leadership

Though we are a small program we offered new ideas and provided leadership in transportation research at the national and regional levels.

- We worked to build a ***National Transportation Knowledge Network*** through the Research Administrator's membership on a TRB Policy Committee Study and through production of a brochure and video on transportation in the information age.
- We assumed lead state role on five pooled fund projects: Clear Roads Winter Maintenance Research, Transportation Library Connectivity, Asset Management, Deer-Vehicle Crash Information Clearinghouse, and the North Central Pavement Research Coordination Partnership (in cooperation with WHRP).

Information Services

Recognizing that research must be understood and implemented to have value, we work to identify existing research and communicate results of our projects to potential users within the department.

- We provided information-gathering services to the entire department through on-demand literature searches, comprehensive synthesis reports and targeted e-newsletters aimed at helping staff learn from the research and best practices of others.
- We summarized the results of every completed WisDOT research project in an easy-to-read two-page brief that captures the research objectives, methodology, results, and impact on the department's procedures.
- We made reports, briefs, videos and newsletters available on the WisDOT Web site for easy access and dissemination.
- We funded and helped coordinate a peer exchange for the Bureau of Equity and Environmental Services, the third such effort we supported within the department to help advance knowledge sharing and adoption of the best practices of other state and federal transportation agencies.

LOOKING AHEAD

The challenges and opportunities ahead will require us to work smarter and more effectively if the WisDOT Research Program is to continue as a vital contributor to the department's overall success. In keeping with the WisDOT Strategy 2006–07, we will strive to ***sustain our commitments, address new realities*** and ***integrate our actions*** with other department programs and state agencies, and with our partners in academia and industry. We will endeavor to:

- Maintain existing research commitments to continue bringing innovation to Wisconsin transportation and to meet the department's need for dollar-saving technologies and procedures.
- Support pilot technology transfer efforts through the new Construction and Materials Support Center.
- Move toward development of a WHRP Collaborative Engineering Center guided by a new Technical Oversight Committee on Information Management.
- Continue developing clearer and more effective ways to implement and measure the benefits of research investments at state, regional and national levels.
- Continue to strengthen partnerships with FHWA, Wisconsin universities, contractors and consultants.
- Look for mutually beneficial ways to partner with UW–Madison as it expands its transportation research centers in the coming years.
- Continue to find ways to leverage regional and national research for the benefit of Wisconsin.
- Maintain a balance between materials/construction research and multimodal, policy and operations research; between conducting traditional research projects and communicating and implementing results; and between Wisconsin and regional/national projects.
- Gain awareness of, and promote the value of, diverse research efforts being conducted within WisDOT or through our partners.
- Use the upcoming research peer exchange to continue process improvement efforts.

Research Project Impacts

Many of the research projects completed or active in 2005 are already having positive impacts on WisDOT. We highlight these impacts by research area and include quantifiable benefits where possible. We include both Wisconsin projects and pooled fund studies in which we participate with other states. For further details on project funding, investigators, WisDOT project managers and completion dates, see the *Project Reference Guide*.

ASPHALT PAVEMENT

Base funding for North Central Superpave Center

Pooled Fund TPF-5(021)

Project Web page
www.pooledfund.org/projectdetails.asp?id=9&status=6

WisDOT's support of this regional center at Purdue University helps fund an array of technical activities related to hot-mix asphalt that are of immediate benefit to the department. Topics include porous asphalt, surface friction characteristics, real-time pavement thickness measurement, compaction monitoring, and foamed asphalt.

IMPACT Ongoing data and information sharing through the pooled fund study on subjects such as binder acceptance criteria has saved the department many times its annual investment, and research completed through this pooled fund has reduced the need for WisDOT-sponsored research.

The Effect of Pavement Lift Thickness on Superpave Mix Permeability and Density

WHRP 0092-02-14c

Final report and brief
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

Water seeping into asphalt pavement can lead to raveling and premature rutting. In 2000 WisDOT began using Superpave criteria in asphalt pavement design, employing coarser aggregates in asphalt and thereby rendering it less dense and more permeable. However, WisDOT lacked a standard protocol for assessing mix permeability during design.

IMPACT This research points toward the use of effective coring tests for coarser mixes, and recommends new density level targets for finer mixes. These new practices should assure that asphalt pavements experience less rutting and raveling, extending their service lives and saving money.

Using the Gyratory Compactor to Measure Mechanical Stability of Asphalt Mixtures

WHRP 0092-01-02

Final report and brief
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

An important tool in effective Superpave design is the Superpave Gyratory Compactor, which identifies certain volumetric characteristics of mixes in relation to compaction cycles. However, current SGC information is of little help in predicting rutting performance and on-site workability for road builders.

IMPACT This study offers an innovative method for using the SGC to estimate stiffness and rutting resistance of mixtures, new possibilities that do not require new testing equipment. The approach detailed in this project has been met with nationwide enthusiasm among asphalt engineers as a design tool that will lead to longer-lasting asphalt pavements.

Guidelines for PG Binder Selection in Wisconsin

WHRP 0092-01-01

Final report and brief
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

This study gives WisDOT pavement designers guidance on selecting the most appropriate performance graded binder for each asphalt paving project—based on resistance to rutting, anticipated traffic speeds and volumes, seasonal temperature variations, and mixing and compacting requirements.

IMPACT Optimizing PG binder selection has the potential to add years to an asphalt pavement's service life. Extending the service life of a standard two-lane rural asphalt highway by even two years saves WisDOT and taxpayers $40,000 per lane mile over the life of the pavement (building such a structure costs roughly $400,000 per lane mile).

Development of Rational Overlay Design Procedures for Flexible Pavements

WHRP 0092-00-05

Final report and brief
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

WisDOT currently relies on empirically based design methods for hot-mix asphalt overlays rather than on more sophisticated mechanistic models. This research points to these new mechanistic methods for evaluating the condition of the existing pavement in order to construct overlays that will last beyond their current 12-year life expectancy.

IMPACT An inch-thick HMA overlay on a standard rural two-lane highway costs about $33,000 per lane mile, or $2,750 per year over its expected life. If application of these new procedures in Wisconsin extends overlay life by two years, annualized costs would be reduced by $400 per lane mile—more than 14%. Overlay design methods recommended through this project will also ease WisDOT's transition from current practice to the new AASHTO Mechanistic-Empirical Design Guide now under review.

Development of Modulus-to-Temperature Relations for HMA Mixtures in Wisconsin

WHRP 0092-03-14

Final report and brief
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

The new AASHTO Mechanistic-Empirical Design Guide under WisDOT review will yield more sophisticated, site-sensitive asphalt pavement design methods. But to work best in Wisconsin, the M-E Guide will require Wisconsin-specific inputs for various properties, including air temperature.

IMPACT This study provides Wisconsin-specific design inputs for use with the M-E Guide, linking them to the critical M-E design property dynamic modulus, the ability of material to spring back from recurring loading stress. It provides WisDOT with excellent starting data for dynamic modulus for various mixture types and air temperatures.

CONCRETE PAVEMENT

Effects of Ground Granulated Blast Furnace Slag in PCC

WHRP 0092-02-14a

Final report and brief
www.dot.wisconsin.gov/library/research/reports/concrete.htm

Ground granulated blast furnace slag, a steel manufacturing byproduct, has yielded mixed results as an alternative cementitious material in Wisconsin cement concrete pavements. Using slag may lengthen the pavement's curing time, especially in cold weather. In the past, the percentage of slag included in a mixture was based on field observation.

IMPACT This study shows that carefully using slag to replace up to 30% of the cement content in concrete pavement mixtures will yield longer pavement lives, effectively meet recycled materials use requirements in federally funded projects, and reduce landfill use in the state.

Effects of Heavy Loading on Wisconsin's Concrete Pavements

WHRP 0092-05-06

Final report and brief
www.dot.wisconsin.gov/library/research/reports/concrete.htm

Current design practices, based on AASHTO guidelines from 1972 with revisions in 1981, do not account for overloading of concrete pavements typical of certain rural regions of Wisconsin. In 2001 two highway sections near Rhinelander failed less than halfway into their 20-year design life due in part to overloaded logging trucks. Replacing such pavements can cost over $400,000 per lane mile.

IMPACT This study offered design suggestions that may prevent expensive pavement failures in the future. The suggestions will also be helpful in progressing toward adoption of the new AASHTO Mechanistic-Empirical Design Guide.

GEOTECHNICS

Soil Mixing Methods for Highway Applications

Pooled Fund TPF-5(001)

Project Web page
www.pooledfund.org/projectdetails.asp?id=125&status=4

Still in progress, this study has already furthered understanding of the design and construction of soil mixing methods to strengthen foundations for highways and embankments in areas with peat and similar poor soils.

IMPACT A design manual and draft specifications are being developed that will save staff and contractor time when WisDOT begins using deep soil mix technology.

Determination of Influences on Support Strength of Crushed Aggregate Base Course Due to Gradational, Regional, and Source Variations

WHRP 0092-02-01

Final report and brief
www.dot.wisconsin.gov/library/research/reports/geotechnics.htm

This investigation established expected resilient modulus values—a key input in the AASHTO Mechanistic-Empirical Design Guide currently under department review—for sands and crushed aggregate base courses in each geographically distinct region of Wisconsin. Until the M-E Guide is implemented, engineers will use the data from this study to guide more judicious use of CABC than current practices allow.

IMPACT Reduced use of CABC beneath a typical four-lane concrete highway may yield significant savings; each one-inch reduction saves roughly $6,000 per lane mile.

Application of EMG Technology in Subsurface Investigations

WHRP 0092-04-08

Final report and brief
www.dot.wisconsin.gov/library/research/reports/geotechnics.htm

Current WisDOT subsurface investigation procedures use intermittent soil borings to characterize conditions, a process that may miss important features in the spaces between the borings. Investigators have identified firms that use electromagnetic geophysics (EMG) equipment to identify subsurface materials by measuring their levels of electrical conductivity.

IMPACT Use of EMG methods with conventional soil borings can potentially save hundreds of thousands of dollars on a project by identifying subsurface problem areas before construction begins, when remediation is far less costly.

STRUCTURES

Health Monitoring of Bridge Structures and Components Using Smart Structure Technology

WHRP 0092-04-14

Final report and brief
www.dot.wisconsin.gov/library/research/reports/structures.htm

Advanced technologies make it possible to monitor a bridge's structural health without human intervention. These "smart" systems may employ acoustic or fiber-optic sensors, for example, to identify wire breaks in prestressed concrete or cable supports.

IMPACT Although these technologies are not yet mature enough for WisDOT use, this study identified promising systems used by other states, offering early data that WisDOT is using in a broad assessment of structural monitoring systems that will span the next few years.

Rehabilitation Techniques for Concrete Bridges

WHRP 0092-01-06

Final report and brief
www.dot.wisconsin.gov/library/research/reports/structures.htm

Deterioration of concrete substructure (below-deck) beams can significantly shorten bridge life. This study produced software for use in damage assessment and treatment, and identified polymer-resin coatings for beam ends that can be used both to cover patches of beam ends, and more effectively in coating beam ends before installation.

IMPACT These coatings, already being used by WisDOT and the subject of the WHRP Structures TOC's first implementation project, can add up to 30 years of life to concrete beams, eliminating beam end performance as an impediment to structural life. Bridges can now be re-decked two or more times before replacing beams.

Non-Destructive Testing of Highway Bridge Structures for Purposes of Structure Evaluation

WHRP 0092-00-15

Final report and brief
www.dot.wisconsin.gov/library/research/reports/structures.htm

A bridge deterioration evaluation guide produced by this study identifies 24 typical problems and visual indicators of deterioration in concrete and steel structures in Wisconsin, linking these signs to 40 deterioration mechanisms and 42 appropriate non-destructive evaluation methods for assessment.

IMPACT WisDOT recently distributed the guide produced in this study to its bridge inspectors. This guide allows for situation-sensitive investigation of structural problems and appropriate repairs, saving engineers time and maximizing treatment impact.

ENVIRONMENT

Fresh Water Mussel Study

COR 0092-01-09

Final report and brief
www.dot.wisconsin.gov/library/research/reports/environment.htm

The Wisconsin Environmental Policy Act requires an assessment of the impact of highway and bridge construction projects on the state's 50 native freshwater mussel species, 28 of which are listed as endangered, threatened, or of concern. This project developed standard procedures for documenting mussel distribution.

IMPACT A single underwater mussel survey can cost between $50,000 and $100,000. This project created an online mussel atlas that allows project managers to quickly locate sites of previous mussel surveys, potentially saving significant preconstruction time and money.

OPERATIONS

Traffic Control Device Consortium

Pooled Fund TPF-5(065)

Project Web page
www.pooledfund.org/projectdetails.asp?id=281&status=4

This pooled fund study evaluates new traffic control devices and their implementation, addressing human factors and operations issues. During WisDOT's involvement in this study, we have participated in roadway safety research projects valued at $700,000.

IMPACT Two of the projects completed through this study would have cost WisDOT $170,000 to conduct on its own. One study evaluated relatively low-cost pavement marking patterns that reduced speeds by 4 to 5 mph, offering a tool that could reduce fatalities and injuries.

Transportation Management Center Study

Pooled Fund SPR-2(207)

Project Web page
www.pooledfund.org/projectdetails.asp?id=106&status=6

WisDOT's investment in this study yielded valuable guidance for launching the Wisconsin statewide Traffic Operations Center in Milwaukee in June 2005. It is useful as WisDOT plans to expand the center into a clearinghouse for notification of incidents anywhere on the system.

IMPACT Developing comparable information on our own for the management of Wisconsin's Traffic Operations Center would have cost WisDOT millions of dollars.

Aurora Program

Pooled Fund SPR-3(042)

Project Web page
www.pooledfund.org/projectdetails.asp?id=189&status=4

WisDOT is able to participate in $300,000 worth of research each year for an annual $25,000 contribution. Research sponsored by Aurora improves Road Weather Information Systems that give maintenance crews real-time weather information for responding quickly and effectively to winter storms.

IMPACT Aurora projects included a study on the accuracy of road sensors that measure surface pavement temperature, critical information for deciding how much salt to use and when. Knowing exact pavement temperatures saves WisDOT money every year in reduced salt use.

POLICY AND PLANNING

Examining Stress Levels of DSP Enforcement Personnel and Intervention Techniques, Phase II

COR 0092-03-01

Final report and brief
www.dot.wisconsin.gov/library/research/reports/policy.htm

Building on a previous study, WisDOT's Employee Assistance Program worked with State Patrol managers and union representatives to test a training program for reducing stress. Program participants rated the training highly on their evaluations: 88% gave the program an 8 or higher on a scale of 1 to 10.

IMPACT Officers' use of the stress management techniques introduced in this program may reduce stress-caused costs, such as lost workdays, lower productivity, workers' compensation costs, and employee turnover.

SAFETY

Midwest States Crash Testing Program

Pooled Fund SPR-3(017)

Project Web page
www.pooledfund.org/projectdetails.asp?id=162&status=6

Performance testing of new roadside safety hardware with crash tests is critical to driver safety but also very costly—as much as $50,000 per test. Through this pooled fund effort Wisconsin and 10 other states share the cost of design, development and testing.

IMPACT Wisconsin's annual contribution of $50,000 leverages $500,000 worth of testing every year at the test facility at the University of Nebraska–Lincoln.

Smart Work Zone Deployment Initiative

Pooled Fund TPF-5(081)

Project Web page
www.pooledfund.org/projectdetails.asp?id=303&status=6

This pooled fund study supports work zone research among member states. For example, a Wisconsin study on portable ITS devices in work zones showed cost savings for motorists and a reduction in crashes.

IMPACT Firsthand knowledge of technologies evaluated by other states helped WisDOT identify those with the greatest promise for Wisconsin, including a dynamic lane merge system used on an I-94 construction project, portable rumble strips, and radar speed display boards.

Information Services Impacts

The Research and Library Unit is providing national leadership in the area of transportation information services. Our collaboration with other states to improve transportation libraries and information exchange is influencing the shape of national policy and practice. Our suite of technical communication products provides critical support for our research programs and has served as a model for other states. We highlight here some of the impacts of these efforts, providing quantifiable benefits wherever possible.

Transportation in the Information Age

With the leadership of WisDOT's Research Administrator, WisDOT joined several other state DOTs to call national attention to the importance of transportation libraries and information services. To tell this story, the Research and Library Unit created and produced *Transportation in the Information Age: The Leadership and Investment Challenge.*

Available as both a brochure and video at
www.dot.wisconsin.gov/library/research/reports/ntkn-video.htm

IMPACT More transportation leaders are beginning to see that the process of creating, capturing, synthesizing and transferring new information to transportation professionals is a vital, but severely underfunded, activity; that a world-class transportation system depends on world-class research put effectively in the hands of practitioners.

TRB Special Report 284

The WisDOT Research Administrator was a key member of the TRB Committee for a Future Strategy for Transportation Information Management, formed at AASHTO's request "to take a fresh look at how transportation information should be managed and provided." The committee recently produced *Special Report 284, Transportation Knowledge Networks: A Management Strategy for the 21st Century*

Available on the TRB Web site at
trb.org/publications/sr/sr284.pdf

IMPACT The committee recommended creating "decentralized, managed networks linking information providers to users wherever they are located." Progress toward establishing these networks will bring tangible benefits to WisDOT and other state DOTs.

Transportation Library Connectivity Pooled Fund Study

WisDOT solicited the participation of nine other partners to form the Transportation Library Connectivity Pooled Fund Study (TPF-5(105)), with Wisconsin as the lead state, an example of states working together "to support the systematic organization of state, federal, academic and private sector libraries."

IMPACT After only a few months in existence the pooled fund study is actively providing technical assistance to participating libraries and supporting the growth of information and knowledge networks through marketing and outreach activities. See the Library Connectivity Pooled Fund Web site at *www.libraryconnectivity.org* and the News, Updates and Resources blog at *www.ctcandassociates.com/lpfblog.*

Information Commons

We initiated a pilot effort to make transportation information more accessible and user-friendly for WisDOT staff in every division. We are reconfiguring the Hill Farms Library to make it an Information Commons — a learning center that facilitates sharing of physical and digital information resources both on-site and remotely through Webcasts and Web conferences.

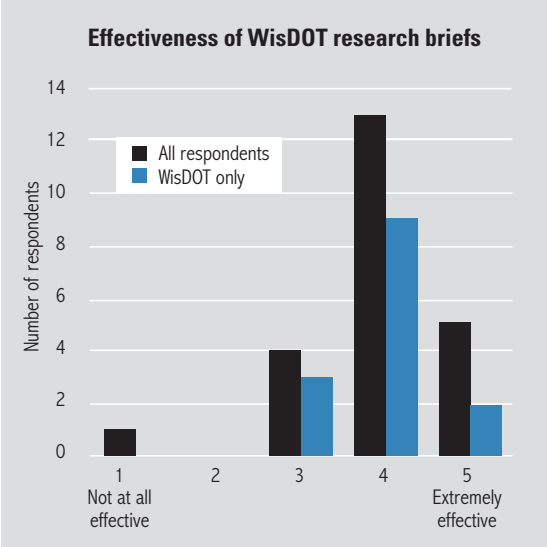
IMPACT This Research and Library partnership will make a wider range of information resources quickly available to WisDOT staff, helping them more effectively handle the challenges of their jobs. Librarians and other staff will be available to assist in the use of databases and other technology for identifying critical information when it is needed, in the form it is most useful.

Research Briefs

We produced 15 research briefs in FFY 2005 on projects completed through the WHRP and COR programs. These two-page summaries outline research objectives, findings and applications, and plans for implementation. See the attached *Project Reference Guide* for completed projects.

Briefs are available online at this link and associated pages
www.dot.wisconsin.gov/library/research/reports/asphalt.htm

IMPACT Research briefs save time for WisDOT staff and investigators in reviewing completed research; provide an easy way for project managers to share results with staff in other areas; and facilitate technology transfer to local governments. In a survey, 78% of respondents rated the briefs a 4 or 5 on their effectiveness at "providing a concise, easy-to-understand summary" of the research (see graph).



Literature Searches

Transportation Literature Searches gather citations of completed research on topics requested by WisDOT technical staff. These targeted keyword searches identify a representative bibliography of studies available on the requested topics. Six TLSs were produced in FFY 2005.

IMPACT WisDOT staff use literature searches to inform research proposals, avoid duplicating research, and identify investigators and organizations with specialized expertise in a subject area.

Transportation Synthesis Reports

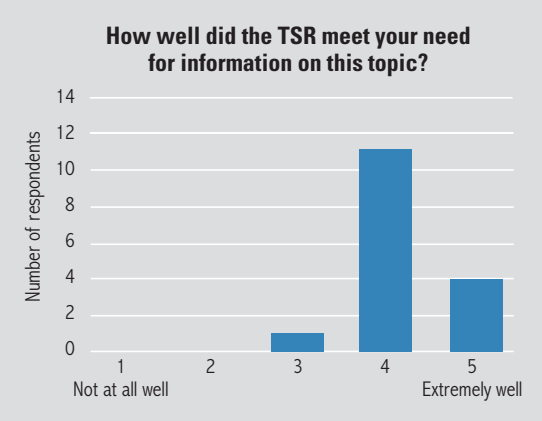
We produced 23 Transportation Synthesis Reports during FFY 2005 in the following issue areas:

Internal Auditing, Overweight Permits, Pavement Markings and Sign Coatings, Certification of Survey Technicians, Mainstreaming Operations Functions, Workforce Development, Performance Measures for Business Functions, Graduated Driver License Programs, Suicide Prevention on Bridges, Information Management, Secondary Impacts, Constructability Reviews, Bridge Deck Overlays, Clear Zones, DBE Research and Best Practices, Bridge Drainage, Roundabout Pavement Design, Full-Depth Asphalt Pavements, Maintenance Emergency Response Time Standards, Accelerated Construction Techniques, Applications for RFID Technology, Process Mapping, and Corridor Management

Based on Internet, library and telephone research, these annotated, quick-turnaround reports compile in a concise, readable format pertinent research and practices on topics requested by WisDOT staff.

Completed TSRs are available at
www.dot.wisconsin.gov/library/research/reports/tsr.htm

IMPACT TSRs allow WisDOT staff to learn from the experiences of other state DOTs, avoid duplicating research, identify new technologies and practices that save time or money or enhance safety, make better investment decisions, and monitor federal guidelines and key transportation trends. In a survey, 83% of respondents indicated they "had applied or anticipated applying information in the TSR to improve processes, make decisions, implement technology, or make other changes." In the survey, 94% rated the TSRs 4 or 5 on how well they met information needs (see graph).

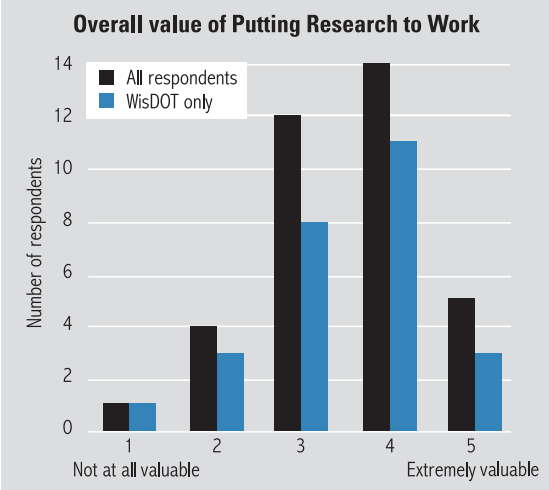


E-Newsletter – Putting Research to Work

Published monthly through September 2005, Putting Research to Work focused on the application of research results in real-world projects in the areas of design, construction, operations and safety. PRTW highlighted success stories from the field that showcased applications of highway research and technology.

The last 14 issues of PRTW are archived online at
www.dot.wisconsin.gov/library/research/reports/rdt.htm

IMPACT PRTW brought WisDOT staff the latest technical news and best practices from the U.S. and around the world—examples of other DOTs solving some of the same problems that WisDOT faces. In a survey, 22% of respondents said they had used new technology that they read about in PRTW in their jobs, and 53% said the overall value of PRTW in their jobs was a 4 or 5 on a 5-point scale (see graph).

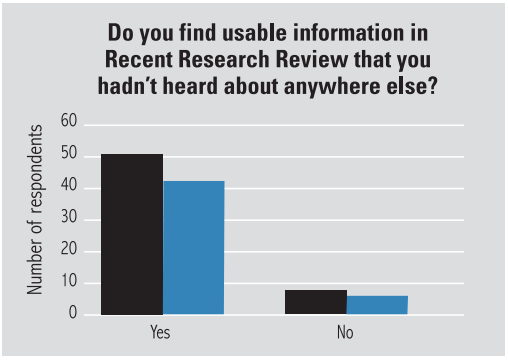


E-Newsletter – Recent Research Review

Published from April to October 2005, Recent Research Review presented a digest of very recent transportation research by state DOTs, universities, TRB and FHWA, and international agencies. This e-newsletter summarized research on specific topics including design, operations, pavements, geotechnics, structures, policy and planning, and safety.

The last issue of RRR is online at
www.dot.wisconsin.gov/library/research/reports/researchreview.htm

IMPACT RRR provided information about research projects at other agencies shortly after publication, allowing WisDOT staff to make immediate use of the information in their jobs. RRR allowed WisDOT to leverage the investments of other states to improve its own practices and procedures. In a survey, 88% of respondents said they found usable information in RRR that they hadn't heard about anywhere else (see graph), and 36% said the overall value of RRR in their jobs was a 4 or 5 on a 5-point scale .



Peer Exchange

In August, WisDOT hosted representatives from five states and FHWA at a peer exchange for the Bureau of Equity and Environmental Services on the indirect and cumulative impacts of transportation projects. The attendees shared experiences and best practices, and Lamar Smith from FHWA–Washington gave an extended presentation that was available to obervers nationally via Webcast. The Research and Library Unit provided funding for the peer exchange and assistance with planning, organization, and report preparation.

Peer exchange final report and FHWA Webcast available online at
www.dot.wisconsin.gov/library/research/reports/peerexchange.htm

IMPACT BEES staff is using the information gathered in the peer exchange in its efforts to develop and implement a formal department policy on indirect and cumulative impacts, which will aid regional and statewide bureau staff in dealing with these complex issues. All four survey respondents rated the value of the peer exchange as valuable or extremely valuable, and all respondents rated the peer exchange format as extremely effective.

Wisconsin TRB Guide

For the third year, RCSS published a *Wisconsin Guide to the TRB Annual Meeting*. This guide highlighted the contributions of WisDOT staff and Wisconsin university researchers who served as presenters and session leaders.

The 2006 TRB Guide is available online at
www.dot.wisconsin.gov/library/research/docs/annualreports/trbguide2006.pdf

IMPACT The annual TRB Guides showcase the breadth and depth of Wisconsin transportation research for both state and national audiences. They help state attendees find Wisconsin sessions easily and facilitate dialogue among WisDOT, academic and private-sector transportation professionals about the state's growing research expertise.

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www.dot.wisconsin.gov/library/research/reports